Consolidated Systems (CS) Gateway to Human Exploration and Development of Space (HEDS) Technology Demonstration (HTD)
Interface Description Document (IDD)

Checkout and Launch Control Systems (CLCS)

84K00370

Approval:

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REVISION HISTORY

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Dates of issue of change pages are:

Page No.	A or D*	Issue or Change No.	CR No.	Effective Date**

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CONSOLIDATED SYSTEMS (CS) GATEWAY TO HUMAN EXPLORATION AND DEVELOPMENT OF SPACE (HEDS) TECHNOLOGY DEMONSTRATION (HTD) INTERFACE DESCRIPTION DOCUMENT (IDD)

CHECKOUT AND LAUNCH CONTROL SYSTEMS (CLCS)

1. SCOPE

This document defines the interface requirements between the Consolidated Systems (CS) Gateway and the HTD.

1.1 OVERVIEW

The Real Time Processing System (RTPS) is a subsystem of CLCS and will be used to process HTD data. The RTPS provides the capability to checkout and control the elements of the current Space Transportation System (STS) and Ground Support Equipment (GSE). It consists of four different processor types called Gateways, Command and Control Processors (CCP), Data Distribution Processors (DDP) and Command and Control Workstations (CCWS). The gateways provide the RTPS with an interface to end items. The Consolidated Systems (CS) Gateway is one of several types of gateways used in the RTPS and will be used as the interface to the HTD. The CS Gateway supports both uplink and downlink to the HTD.

The purpose of the HTD is to demonstrate off-the-shelf sensing technologies in an operational environment. The HTD will be installed in the orbiter and is based on the VMEbus using the VxWorks realtime Operating System (OS). The communication between the CS Gateway and the HTD will be via the T-0 interface using the Ethernet protocol.

2. APPLICABLE DOCUMENTS

[1] Integrated Vehicle Health management HEDS Technology Demonstration System Requirements Document IVHM HDT-1, HTD-SYS-001

[2] TCP/IP Protocols, IEEE 802.3

3. CS GATEWAY TO HTD PHYSICAL INTERFACE DESCRIPTION

3.1 ELECTRICAL CHARACTERISTICS

The physical interface between the CS Gateway and the HTD uses the Ethernet Local Area Network (LAN) technology as described in the IEEE 802.3 standard.

3.2 CONNECTOR TYPE

The CS Gateway requires an RJ-45 connector for the Ethernet interface.

4. CS GATEWAY TO HTD SOFTWARE INTERFACE

4.1 PROTOCOL

The protocols used to transfer information across the interface are the Ethernet TCP/IP. These protocols are described in the IEEE standards as listed in Section 2. The HTD will be configured as the server and the CS Gateway configured as the client.

4.1.1 Network Connections

Upon power-up of the HTD, the HTD will be initialized to a ready state “listening” for a connection from the CS Gateway. When the CS Gateway receives the Activate Data Acquisition (ADA) from the Command and Control Processor (CCP), it will initiate an open connection with the HTD box. The CS Gateway will open up two sockets with the HTD. One socket will be used by the CS Gateway to send commands to the HTD and the other socket will be used by the HTD to send data to the CS Gateway. Once the socket used to send data to the gateway has been established, the HTD will begin to send data.

4.2 STREAM FRAME FORMAT

The CS Gateway uses a frame structure called a Stream Frame to communicate with the HTD. This frame is transmitted using the Ethernet TCP/IP protocol and is used for both uplink and downlink. The structure of the Stream Frame is shown in the figure below.

Start Marker (32 bits)	Source/Destination (32 bits)	Data Length (32 bits)	Data (variable)	End Marker (32 bits)

Figure 4-1 Stream Frame Format

4.3 UPLINK COMMANDS[1]

The gateway will attempt to establish a connection with the HTD uplink after it receives an Acquire Data Acquisition (ADA) command from the Command and Control Processor (CCP). Once the gateway establishes a connection with the HTD, it uses this “command socket” to send commands and receive command responses.

The HTD unique commands originate at the Command and Control Workstation (CCWS) and are routed through the CCP to the gateway. Once the gateway receives the command from the CCP, it converts the command into the Stream Frame Format, sends it to the HTD via the “command socket” and waits for a response. When the gateway receives a response, it forwards the response back to the CCP.

[1] Uplink commanding from CLCS is optional for HTD 1 and a requirement for HTD 2

4.3.1 Uplink Rate

The uplink command rate shall not exceed 1 command per second.

4.3.2 Gateway to HTD Command Format

The CS Gateway receives a command Function Designator Identification (FDID) and a parameter value from the CCP via the Realtime Critical Network (RTCN). The gateway converts the FDID to the appropriate 8 bit "command type" and begins building the HTD command. The parameter value received from the CCP is inserted into the "argument" field as a 16 bit integer. The figure below shows an example of an HTD command that is sent from the gateway.

Start Marker	Frame ID	Data Length	cmd	arg	End Marker
OxA50DB573	0x00000000	0x00000003	0x52	0x0001	0x375BD05A

Figure 4-2 Command Example (RESET)

4.3.3 HTD to Gateway Command Response Format

In response to commands received from the gateway, the HTD sends back a response to indicate whether or not the command was received successfully. This type of response is provided for all commands.

The gateway receives command responses from the HTD as a stream frame. The frame contains a "status" field to indicate the command was acknowledged (ACK) or not acknowledged (NACK). The gateway forwards the contents of the "status" field back to the CCP. The command and argument fields are an "echo" of the command and argument fields as they were received in the HTD. The figure below shows an example of a command response that is sent from the HTD.

Start Marker	Frame ID	Data Length	stat	cmd	arg	End Marker
OxA50DB573	0x00000001	0x00000004	0x06	0x52	0x0001	0x375BD05A

Figure 4-3 Command Response Example (RESET command)

4.3.4 Uplink Fields

The following Table shows the valid data field entries for the uplink path.

Field	Subfield	Length	Description	Value	Notes
Start Marker	n/a	32	n/a	0xA50DB573	
Frame ID	n/a	32	CLCS to HTD	0x00000000	command
	n/a		HTD to CLCS	0x00000001	cmd response
Data Length	n/a	32	No. of bytes in Data	0x00000003	command
				0x00000004	cmd response
				0x00000005	GMTLO command
				0x00000006	GMTLO response
Data	Cmd Type	8	Reset	0x52	ASCII ‘R’
		8	Self Test	0x54	ASCII ‘T’
		8	Change Mode	0x4D	ASCII ‘M’
		8	Load File	0x4C	ASCII ‘L’
		8	Download Data	0x44	ASCII ‘D’
		8	GMTLO	0x47	ASCII ‘G’
	Argument	16	Reset	0-200	decimal
		16	Self Test	0-99	decimal
		16	Change Mode	0-25	decimal
		16	Load File	0-99	decimal
		16	Download Data	n/a	
		32	GMTLO	0-86399	decimal
	Status	8	ACK	0x06	
		8	NACK	0x15	
End Marker	n/a	32	n/a	0x375BD05A	

4.3.5 Load File Command

The Load File command is used by the CS Gateway to initiate file transfers. This command informs the HTD that the gateway will begin to transfer a file once the command response has been received. The actual transfer is performed using the FTP protocol. The file to be transferred is identified in the command argument.

The files are generated by the HTD Project and transferred to the CLCS Project. During system initialization, the files are downloaded onto the gateway’s local hard disk. When the gateway is instructed to send the “Load File” command to the HTD, the gateway first verifies the file exists on the local hard disk. If the file does not exist, the gateway generates a system message and terminates the processing of the command. If no errors have occurred, the gateway sends the “Load File” command to the HTD and waits for the command response. Once the command response is received, it forwards the response to the CCP. If the HTD response was an “ACK”, the gateway then opens up an FTP connection with the HTD and proceeds to send the file. Once the file transfer is complete and no errors have occurred, the gateway sends a system message indicating the file transfer has been completed successfully, otherwise, it send a system message indicating an error occurred during the file transfer.

4.4 DOWNLINK

The HTD will downlink data to the CS Gateway in a Stream Frame format via the Ethernet interface. The Stream Frame is used as the transport vehicle to send a Data Frame. The Data Frame is a structure used to define the data format contained in the “Data” field portion of a Stream Frame. One and only one Data Frame can be inserted into a Stream Frame. The contents of a Data Frame consists of internal HTD status data, a time tag, and sensor data (measurement data).

The HTD is designed to begin sending data to the gateway once the gateway has initiated and established a socket connection for the data downlink. The HTD buffers the sensor data, builds a Stream Frame and sends the frame to the gateway using the data socket.

4.4.1 Downlink Data Rate

The HTD will send out Stream Frames periodically with a minimum time of 10 milliseconds between frames.

4.4.2 Data Frame Format

The HTD project will define and implement a number of Data Frames. Each Data Frame will be assigned a unique Frame ID for identification purposes. When the HTD downlinks data, it will include the Frame ID as part of the Stream Frame. HTD will use any one of the defined Data Frames at any time to downlink data to the gateway. A sample Data Frame format used by HTD 1 can be found in Appendix A.

4.4.2.1 Time Tag[2]

The HTD will provide a time tag in the Data Frame corresponding to when the first sample of that Data Frame was acquired. Each Data Frame will contain one time tag and will occupy bytes 4-11 of the Data Frame. Since there is only one time tag and multiple samples per Data Frame, a Time Offset structure will be provided with each Data Frame format structure by the HTD Project. The Time Offset structure provides time offsets in units of milliseconds to the first sample time tag and is used by the gateway to calculate the time tags for the other samples within the Data Frame. There is a one-to-one correspondence between entries in the Data Frame format structure and the entries in the Time Offset structure. As part of system initialization, the Time Offset structures are downloaded onto the CS Gateway’s local hard disk.

The data type of the time tag is BCD digits except for the units of milliseconds which is defined as a HEX data type. The time tag occupies the following bytes within the Data Frame structure: byte 4 contains the month, byte 5 contains the day, byte 6 contains the hour, byte 7 contains the minute, byte 8 is a spare byte, byte 9 contains the seconds, byte 10 contains the MSB of milliseconds, byte 11 contains the LSB of milliseconds. Appendix A provides a sample of a Data Frame format structure.

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[2] The gateway will reformat the time tag into a 64 bit floating-point number value for plotting purposes.

4.4.2.2 Measurement Data

The measurement or sensor data is contained in the bytes following the time tag. HTD will fill in the measurement data portion of the Data Frame in accordance to one of the Data Frame format structures as described in Appendix A. In the event a measurement does not completely fill the data field, the right justified LSB convention will be used.

5. ERROR CONDITIONS

5.1 NO DATA ACTIVITY

Once the CS Gateway establishes a connection with HTD, data is expected to be received from the HTD at a periodic rate. If the gateway does not receive data after a certain amount of time, it will generate a system message (warning) to indicate the data has dropped out. At this point, the gateway will continue to wait for data until the gateway's OS reports a "dead connection".

5.2 LOSS OF CONNECTION

If the gateway OS reports a "dead connection", the gateway will first attempt to re-establish the connection. If the connection is successfully re-established, the gateway will generate a system message indicating a successful re-connect, otherwise, it will generate a system message indicating a loss of connection. At this point, the gateway will require operator intervention to attempt another re-connect.

5.3 DATA FORMAT ERRORS

The gateway checks the data received from the HTD for data format errors before performing any processing. If an error occurs, the gateway generates a system message.

6. FUNCTION DESIGNATORS (FDs)

HTD FDs include the time, measurement, command and system status FDs. These FDs defined for HTD 1 can be found in Appendix B. The HTD project has the responsibility to provide all the required FD information needed to include the FDs into CLCS.

Appendix-A Sample Data Frame file

The following is a sample Data Frame file used by HTD 1:

FRAME ID: 0X1000001

SAMPLE ONLY

```
/*=================================================================*/
/*              Frame Data Format Structure                        */
/*  Source: polling table file POLLTB1                             */
/*  Created by POLLFRAM edition 1.22 on 02/12/1998 at 13:35:09     */
/*=================================================================*/

/* Internal frame Header (ihdr) version 4, 02/12/98 */
DPS_HEX_8 sb_state;     /* buffer state variable */
DPS_HEX_8 sb_dlstat;    /* download status byte */
DPS_HEX_16 sb_intstat;  /* internal status word */
DPS_BCD_8 sb_month;     /* time of first sample in buffer - months */
DPS_BCD_8 sb_day;       /* time of first sample in buffer - days */
DPS_BCD_8 sb_hour;      /* time of first sample in buffer - hours */
DPS_BCD_8 sb_minute;    /* time of first sample in buffer - minutes */
DPS_BCD_8 sb_spare;     /* time of first sample in buffer - unused fill byte */
DPS_BCD_8 sb_seconds;   /* time of first sample in buffer - seconds */
DPS_DEC_16 sb_mseconds; /* time of first sample in buffer - milliseconds */
/* Measurement Sample data: */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00003, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00018, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00033, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00048, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00063, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00078, slot 0 */
DPS_DEC_16 LH2_TEMP_2;  /* Poll table entry 00087, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00093, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00108, slot 0 */
DPS_DEC_16 HTD_TEMP_0;  /* Poll table entry 00111, slot 0 */
DPS_DEC_16 HTD_TEMP_1;  /* Poll table entry 00114, slot 0 */
DPS_DEC_16 HTD_TEMP_2;  /* Poll table entry 00117, slot 0 */
DPS_DEC_16 HTD_TEMP_3;  /* Poll table entry 00120, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00123, slot 0 */
DPS_DEC_16 PG_PRESS_0;  /* Poll table entry 00138, slot 0 */
DPS_DEC_16 AFT_GO2_0;   /* Poll table entry 00141, slot 0 */
DPS_DEC_16 AFT_GO2_1;   /* Poll table entry 00144, slot 0 */

#define FRAMETYPE 0X1000001
#define FRAMESIZE 0X3E
```

```
/*==============================================================*/
/*          Measurement Sample Time Offset Structure              */
/*  Source: polling table file POLLTB1                            */
/*  Created by POLLFRAM edition 1.22 on 02/12/1998 at 13:35:09    */
/*==============================================================*/

TIME_OFFSET 000.000E-03;        /* Poll table entry 00003, slot 0 */
TIME_OFFSET 100.000E-03;        /* Poll table entry 00018, slot 0 */
TIME_OFFSET 200.000E-03;        /* Poll table entry 00033, slot 0 */
TIME_OFFSET 300.000E-03;        /* Poll table entry 00048, slot 0 */
TIME_OFFSET 400.000E-03;        /* Poll table entry 00063, slot 0 */
TIME_OFFSET 500.000E-03;        /* Poll table entry 00078, slot 0 */
TIME_OFFSET 560.000E-03;        /* Poll table entry 00087, slot 0 */
TIME_OFFSET 600.000E-03;        /* Poll table entry 00093, slot 0 */
TIME_OFFSET 700.000E-03;        /* Poll table entry 00108, slot 0 */
TIME_OFFSET 720.000E-03;        /* Poll table entry 00111, slot 0 */
TIME_OFFSET 740.000E-03;        /* Poll table entry 00114, slot 0 */
TIME_OFFSET 760.000E-03;        /* Poll table entry 00117, slot 0 */
TIME_OFFSET 780.000E-03;        /* Poll table entry 00120, slot 0 */
TIME_OFFSET 800.000E-03;        /* Poll table entry 00123, slot 0 */
TIME_OFFSET 900.000E-03;        /* Poll table entry 00138, slot 0 */
TIME_OFFSET 920.000E-03;        /* Poll table entry 00141, slot 0 */
TIME_OFFSET 940.000E-03;        /* Poll table entry 00144, slot 0 */
```

Appendix-B Function Designators

The following is a list of the FDs used by HTD-1.

NOTE: The only intent of this list is to document the FD Name, nomenclature, data type and length. Any other information needed on a particular FD must be obtained through the Data bank. This list will only be updated if an FD is added or deleted.

		HTD-1 Measurements						
	FD	Nomenclature	Type	Bit length	SBIT	Unit	State	framedef nom (info only)
1	V41R9002C	MPS-1 GH2-1 Concentration (Makel)	Analog	16	0	PPM	NA	
2	V41R9003C	MPS-1 GH2-2 Concentration (Makel)	Analog	16	0	PPM	NA	
3	V41R9004C	MPS-1 GH2-3 Concentration (Makel)	Analog	16	0	PPM	NA	
4	V41R9005C	MPS-1 GH2-4 Concentration (Makel)	Analog	16	0	PPM	NA	
5	V41R9006C	MPS-1 GH2-5 Concentration (Makel)	Analog	16	0	PPM	NA	
6	V41R9007C	MPS-1 GH2-6 Concentration (Makel)	Analog	16	0	PPM	NA	
7	V41T9028C	MPS-1 GH2-1 Temp (Makel)	Analog	16	0	Degrees C	NA	
8	V41T9029C	MPS-1 GH2-2 Temp (Makel)	Analog	16	0	Degrees C	NA	
9	V41T9030C	MPS-1 GH2-3 Temp (Makel)	Analog	16	0	Degrees C	NA	
10	V41T9031C	MPS-1 GH2-4 Temp (Makel)	Analog	16	0	Degrees C	NA	
11	V41T9032C	MPS-1 GH2-5 Temp (Makel)	Analog	16	0	Degrees C	NA	
12	V41T9033C	MPS-1 GH2-6 Temp (Makel)	Analog	16	0	Degrees C	NA	
13	V41X9034B	MPS-1 GH2-1 Heater Status (Makel)	Discrete	1	10	NA	ON/OFF	
14	V41X9035B	MPS-1 GH2-2 Heater Status (Makel)	Discrete	1	11	NA	ON/OFF	
15	V41X9036B	MPS-1 GH2-3 Heater Status (Makel)	Discrete	1	12	NA	ON/OFF	
16	V41X9037B	MPS-1 GH2-4 Heater Status (Makel)	Discrete	1	13	NA	ON/OFF	
17	V41X9038B	MPS-1 GH2-5 Heater Status (Makel)	Discrete	1	14	NA	ON/OFF	
18	V41X9039B	MPS-1 GH2-6 Heater Status (Makel)	Discrete	1	15	NA	ON/OFF	
19	V41M9040P	GH2 Heater Status Word	Digital Pattern (HEX)	16	0	NA	NA	
20	V41R9009C	MPS-1 O2-1	Analog	12	4	PPM	NA	aft_go2_0
21	V41R9011C	MPS-1 O2-2	Analog	12	4	PPM	NA	aft_go2_1
22	V41T9012C	MPS-8 GO2-1 Temp	Analog	12	4	Degrees F	NA	gox_tmp_0
23	V41T9013C	MPS-8 GO2-2 Temp	Analog	12	4	Degrees F	NA	gox_tmp_1
24	V41T9014C	MPS-8 GO2-3 Temp	Analog	12	4	Degrees F	NA	gox_tmp_2
25	V41R9015C	MPS-4 Ghe-1 Primary	Analog	12	4	CNT (*SCIM)	NA	ghe_vpl_0

26	V41R9016C	MPS-4 Ghe-2 Primary	Analog	12	4	CNT (*SCIM)	NA	ghe_vpl_1
27	V41R9026C	MPS-4 Ghe-1 Secondary	Analog	12	4	CNT (*SCIM)	NA	
28	V41R9027C	MPS-4 Ghe-2 Secondary	Analog	12	4	CNT (*SCIM)	NA	
29	V41P9017C	MPS-5 VJ-1 Pressure Channel A	Analog	12	4	*Micron	NA	
30	V41P9018C	MPS-5 VJ-2 Pressure Channel A	Analog	12	4	*Micron	NA	
31	V41P9041C	MPS-5 VJ-1 Pressure Channel B	Analog	12	4	*Micron	NA	
32	V41P9042C	MPS-5 VJ-2 Pressure Channel B	Analog	12	4	*Micron	NA	
33	V41P9019C	MPS-6 Umb. plate pressure	Analog	12	4	PSID	NA	pg_press_0
34	V41G9020C	ME3 Thrust Str Strut -1 Strain	Analog	12	4	*Microstrain	NA	et_strain_0
35	V41G9021C	ME3 Thrust Str Strut -2 Strain	Analog	12	4	*Microstrain	NA	et_strain_1
36	V41T9022C	ME3 Thrust Str Strut -3 Temp	Analog	12	4	Degrees F	NA	et_temp_0
37	V41T9023C	MPS-7 LH2-1 temperature	Analog	12	4	Degrees F	NA	lh2_temp_0
38	V41T9024C	MPS-7 LH2-2 temperature	Analog	12	4	Degrees F	NA	lh2_temp_1
39	V41T9025C	MPS-7 LH2-3 temperature of VJ line	Analog	12	4	Degrees F	NA	lh2_temp_2
40	V09T9000C	PRSD-1 temperature	Analog	12	4	Degrees F	NA	prsd_temp_0
41	V09T9001C	PRSD-2 temperature	Analog	12	4	Degrees F	NA	prsd_temp_1
42	V09T9002C	PRSD-3 temperature	Analog	12	4	Degrees F	NA	prsd_temp_2
43	V09T9003C	PRSD-4 temperature	Analog	12	4	Degrees F	NA	prsd_temp_3
44	V78T8000C	HTD-1 temperature	Analog	12	4	Degrees F	NA	htd_temp_0
45	V78T8001C	HTD-2 temperature	Analog	12	4	Degrees F	NA	htd_temp_1
46	V78T8002C	HTD-3 temperature	Analog	12	4	Degrees F	NA	htd_temp_2
47	V78T8003C	HTD-4 temperature	Analog	12	4	Degrees F	NA	htd_temp_3
48	V78M8004P	System Status Bits	Digital Pattern (HEX)	16	0	NA	NA	
49	V78X8005B	System Status Bit 0	Discrete	1	15	NA	ON/OFF	
50	V78X8006B	System Status Bit 1	Discrete	1	14	NA	ON/OFF	
51	V78X8007B	System Status Bit 2	Discrete	1	13	NA	ON/OFF	
52	V78X8008B	System Status Bit 3	Discrete	1	12	NA	ON/OFF	
53	V78X8009B	System Status Bit 4	Discrete	1	11	NA	ON/OFF	
54	V78X8010B	System Status Bit 5	Discrete	1	10	NA	ON/OFF	
55	V78X8011B	System Status Bit 6	Discrete	1	9	NA	ON/OFF	
56	V78X8012B	System Status Bit 7	Discrete	1	8	NA	ON/OFF	
57	V78X8013B	System Status Bit 8	Discrete	1	7	NA	ON/OFF	
58	V78X8014B	System Status Bit 9	Discrete	1	6	NA	ON/OFF	

59	V78X8015B	System Status Bit 10	Discrete	1	5	NA	ON/OFF	
60	V78X8016B	System Status Bit 11	Discrete	1	4	NA	ON/OFF	
61	V78X8017B	System Status Bit 12	Discrete	1	3	NA	ON/OFF	
62	V78X8018B	System Status Bit 13	Discrete	1	2	NA	ON/OFF	
63	V78X8019B	System Status Bit 14	Discrete	1	1	NA	ON/OFF	
64	V78X8020B	System Status Bit 15	Discrete	1	0	NA	ON/OFF	
65	V78M8021P	System State	Digital Pattern (DEC - Enum)	16	0	NA	NA	
66	V78M8022P	File Transfer	Digital Pattern (DEC - Enum)	16	0	NA	NA	
67	NMPS00001	MPS-4 Ghe-1 Computed Actual Flow	Pseudo Analog	32	0	NA	NA	
68	NMPS00002	MPS-4 Ghe-2 Computed Actual Flow	Pseudo Analog	32	0	NA	NA	
69	V78W8023B	First Sample - Month	Digital Pattern (BCD)	8	0	NA	NA	
70	V78W8024B	First Sample - Day	Digital Pattern (BCD)	8	0	NA	NA	
71	V78W8025B	First Sample - Hour	Digital Pattern (BCD)	8	0	NA	NA	
72	V78W8026B	First Sample - Minutes	Digital Pattern (BCD)	8	0	NA	NA	
73	V78W8027B	First Sample - Seconds	Digital Pattern (BCD)	8	0	NA	NA	
74	V78W8028B	First Sample - Milliseconds	Digital Pattern (HEX)	16	0	NA	NA	
75	V78K8029B	Reset	Digital Pattern Stimulus (DEC)	16		NA	NA	
76	V78K8030B	Self Test	Digital Pattern Stimulus (DEC)	16		NA	NA	
77	V78K8031B	Change Mode	Digital Pattern Stimulus (DEC)	16		NA	NA	
78	V78K8032B	Load File	Digital Pattern Stimulus (DEC)	16		NA	NA	
79	V78K8033B	Zero	Digital Pattern Stimulus (DEC)	16		NA	NA	
80	V78K8034B	Now	Digital Pattern Stimulus (DEC)	16		NA	NA	
81	V78K8035B	GMT LO (N03IS009A)	Digital Pattern Stimulus (DEC)	16		NA	NA	
82	IVHMTSTMP	IVHM - Gateway Computed Time	FP	64		DPL	NA	
		* Units are not valid in CCMS - would default to NULL						
		**identifies the number (from 0) of the 8-bit word where the FD begins.						

	Rev History							
	7 - 18 additional Makel H2 Sensor Measurements - (Roselle 12/10)							
	19 - added parentword for the heater status bits - telecon 12/16							
	27 - 28 additional He measurements (email 11/24)							
	31 - 32 Secondary VJ Pressure Measurements - (Roselle 12/10)							
	66 System FD to aid in the file transfer command, per CLCS request. This FD is also a 16 bit enumerated FD for example, table name. (email - 11/24)							
	67 - 68 user defined function (KSC unique FD) to compensate the actual He flow value. The function would include a division of one value by the other, plus an offset (email - 11/24) V1, V2 are the voltages, and Scale, Offset, B and C are constants TBD							
	69 - 74 users will need to correlate FD value versus onboard MET time post-landing (using PC DAT), our GMT/MET time must be a FD as well (email - 11/24)							
	75 - 80 commands - from Emilio							
	81 command to cyclically uplink GMT LO - Warren							
	82 - added FD for CLCS computed time - based on time of first sample and time offset (Chau 1/20/98)							
	2/12/98 - IVHM FD Actions:							
	Final frame definitions							
	Calibration data for V41R9015C, V41R9016C, V41R9026C, V41R9027C							
	FD changes for ET Door FD's - V41G9020C, V41G9021C, V41T9022C							
	Enumerated State Definitions							
	Discrete State Definitions, Logic0							
	Update Nomenclatures							